

# **Solar & wind power in China and India - Current state, potential, support schemes and scenarios for 2020**

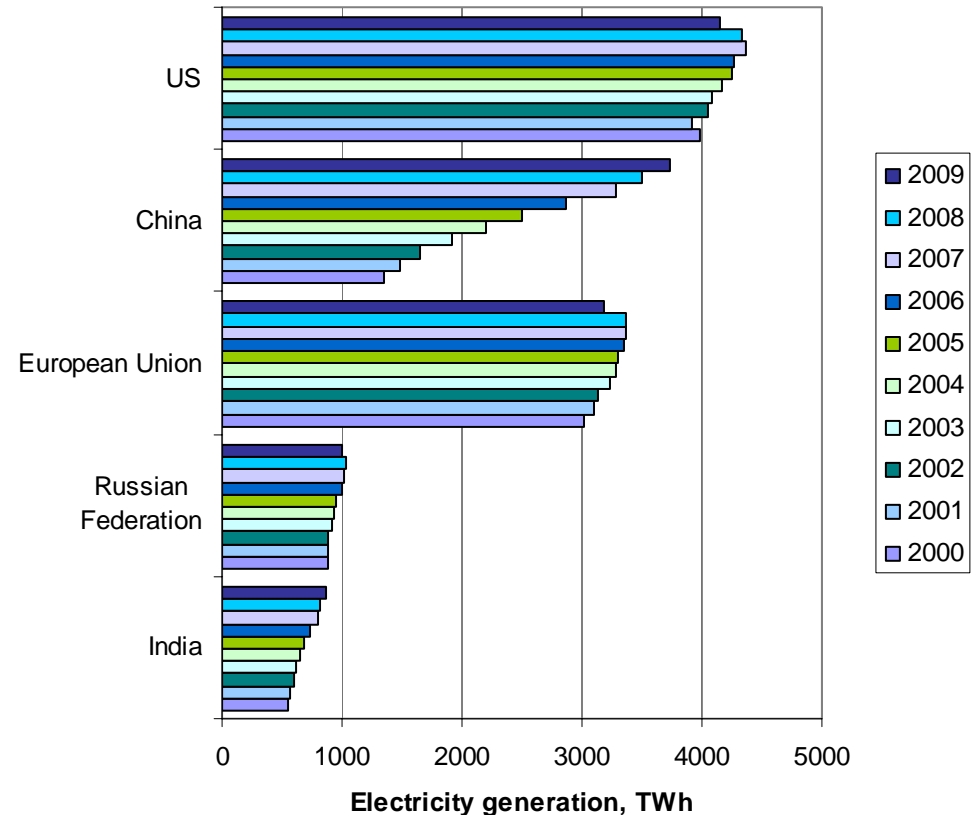
SGEM 3.4 draft 19.10.2010

Maija Ruska & Juha Kiviluoma

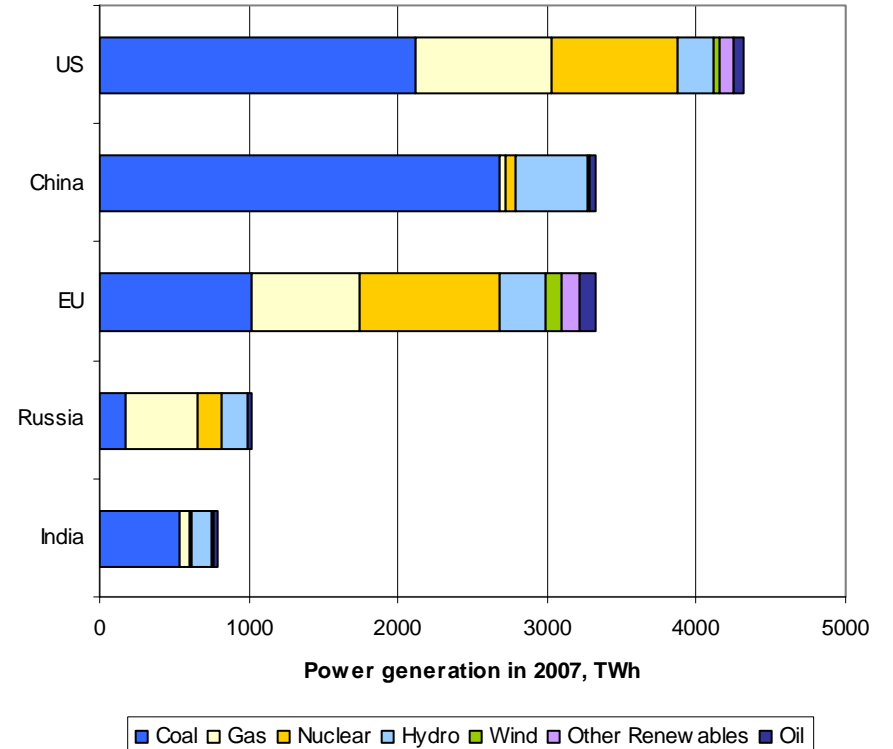
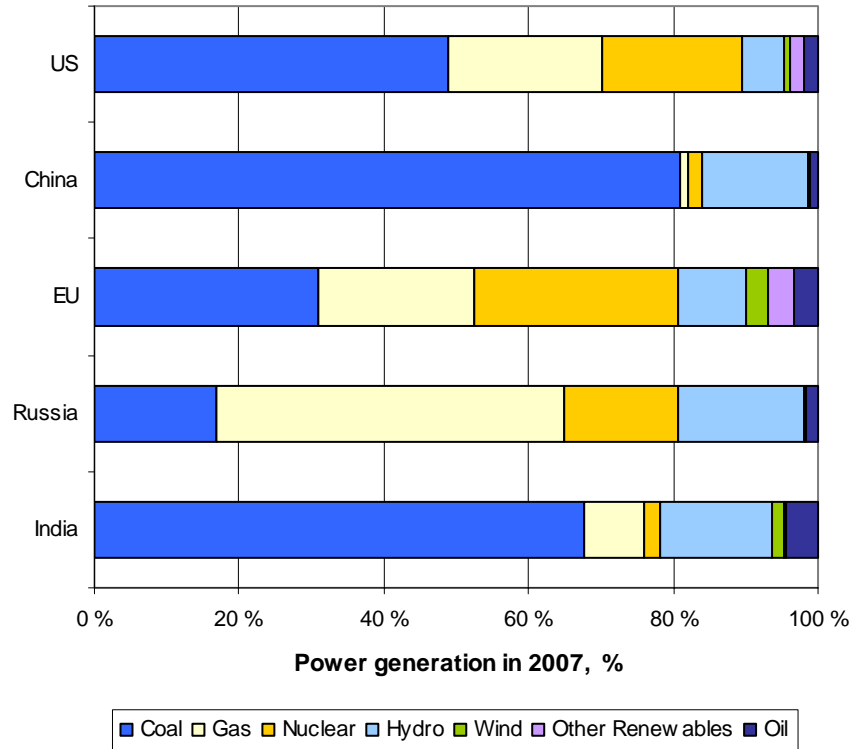
VTT Technical Research Centre of Finland

## China & India - Electricity markets compared to other major regions

- Between 2000 and 2009, China's electricity generation has almost tripled, India's has increased by over 50 %
- Electricity consumption growth derives from both population growth and economic expansion
- Per capita consumption figures still low compared to US or European consumption figures



# Currently, China and India rely heavily on coal-fired power generation



## By 2020, power generation in China and India is expected to double compared to generation in year 2007

- Future power generation, especially capacity structure, depends on climate change mitigation measures

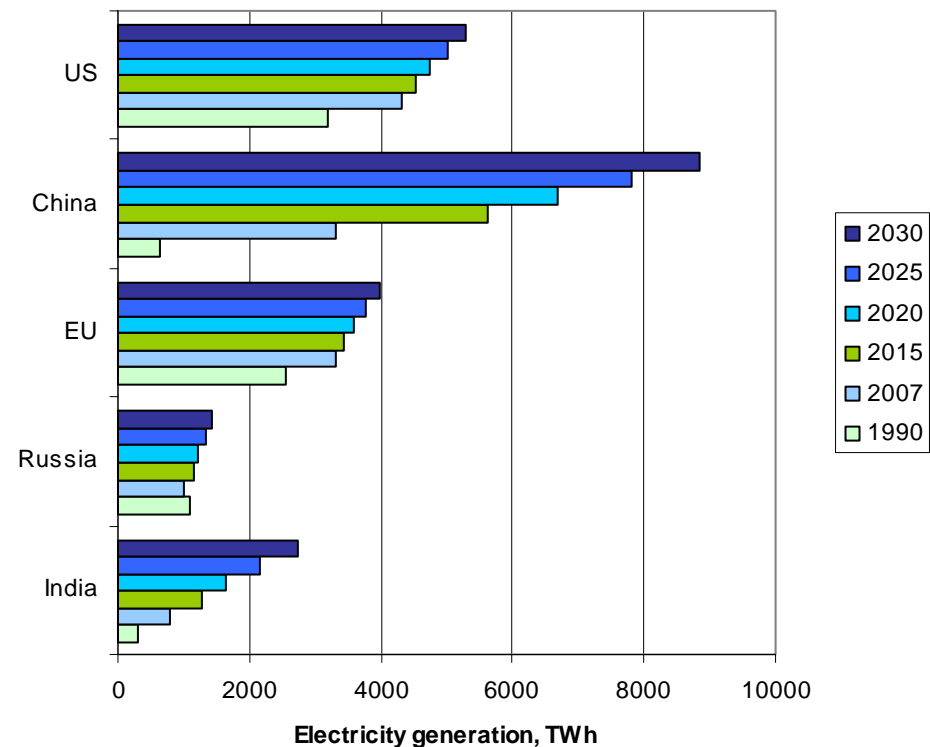
### IEA Reference Scenario

- A picture of how global energy markets would evolve if governments make no changes to existing policies and measures
- Electricity generation growth 2007-2020
  - China 3374 TWh
  - India 858 TWh
  - US 426 TWh
  - EU 262 TWh
  - Russia 207 TWh

### 450 Scenario

- How global energy markets would evolve if countries take co-ordinated action to restrict the global temperature rise to 2 °C
- Changes in 2020 electricity generation compared to the Reference Scenario
  - China: -471 TWh
  - India: - 64 TWh

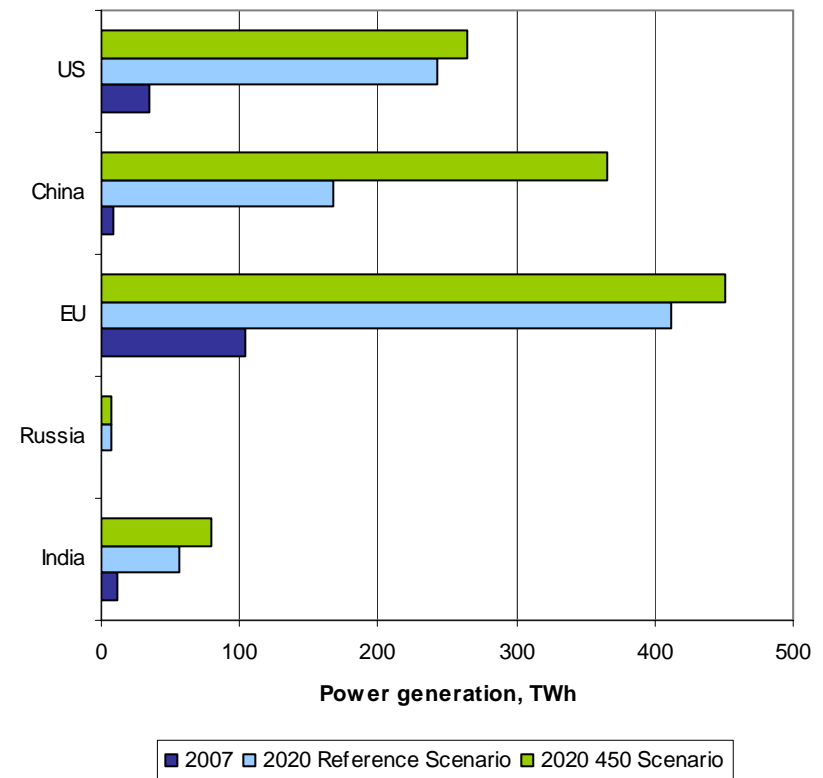
Electricity generation outlook in IEA's WEO 2009  
Reference Scenario



## IEA expects large additions on wind power generation

- EU has already adopted climate change mitigation measures, and differences between Reference and 450 Scenario are small
- In China, future wind power generation depends on measures taken: in 450 Scenario wind power generation is 365 TWh in 2020 compared to 168 TWh in Reference Scenario
- In India, wind power generation in 2020 will be multifold compared to generation in 2007, but market remains much smaller than in US, China or EU
- For solar electricity, specific figures are not available in WEO 2009

IEA WEO 2009: Wind power generation in 2007 and scenarios for 2020





# China

## China - electricity market reform ongoing since 2002



- The State Power Corporation (SCP) - incumbent generator, transmitter and distributor of electricity - was broken up in 2002
- Generator assets were divided into five state-owned generation companies (gencos)
  - China Huaneng Group, China Huadian Power, China Guodian Power, China Datang Corporation, China Power Investment Company
  - Gencos are not allowed to operate more than 20 % share of generating capacity in each province
  - Gencos have 50 % market share
- Two transmission system operators were formed
  - The State Grid Corporation of China (SGCC)
  - China Southern Power Grid Corporation (CSPGC)
- In 2003, the State Electricity Reform Commission (SERC), central regulatory body was established

## Regulatory structure



- State Electric Regulatory Commission ([SERC](#))
  - Oversees power industry
  - Issues licenses to environmentally qualified players
- National Development and Reform Commission ([NDRC](#))
  - Makes strategic and long-term plans for the power sector
  - Plans the spatial distribution of major investment projects
  - Arranges state investment funds for infrastructure
  - Pricing policy
- National Energy Administration ([NEA](#))
  - Under supervision of NDRC
  - Manages operations of the energy sector
  - Formulates standards
  - Guides energy development in rural areas
- Ministry of Finance ([MoF](#))
  - Financial management system, cost monitoring, taxation policy
- Environmental Protection Agency
  - Enforces environmental laws, regulations and standards
- The State-Owned Assets Supervision and Administration Commission ([SASAC](#))
  - Supervises and administers state-owned assets



## Supply and demand



- Vast coal and hydro resources
  - Over 80 % of the electricity generated with coal-fired power plants
  - Hydropower accounted for 15 % of generation in 2007
- Plans to expand nuclear capacity by 2020
  - Problems with high costs and lack of funding
- Generation market shares
  - Central government owned generation companies (gencos) 50 %
  - 40 % from local government-owned power companies
  - 10 % private and foreign independent power producers
- Power shortage problems since 2002
  - Fuel distribution problem: load centers and coal resources are situated in different parts of the country
  - Heavy industrial power users are frequently asked to shut down production during peak times
- Electrification in rural areas only partial, 2 % of people lacking access to electricity
- Over 75 % of the demand comes from industrial sector, only 11 % from residential and 9 % from commercial.

Power generation in 2007	TWh	%
Coal	2685	80,9 %
Oil	34	1,0 %
Gas	41	1,2 %
Nuclear	62	1,9 %
Hydro	485	14,6 %
Wind	9	0,3 %
Other Renewables	2	0,1 %
<b>Total</b>	<b>3318</b>	<b>100 %</b>

## Transmission



- The State Grid Corporation of China ([SGCC](#))
  - Builds and operates power grids in 26 provinces, autonomous regions and municipalities covering 88 % of the national territory
  - 220 kV and above transmission lines total 195 900 km
  - 1,5 million employees, serves 128 million customers
- China Southern Power Grid Co. ([CSG](#))
  - Invests, constructs and operates power networks in Guangdong, Guoangxi, Yunnan, Guizhou and Hainan provinces and regions
  - Service area is of 1 million square kilometers, with a population of 230 million
  - Total installed generation capacity in service areas 160 GW
  - 220 kV and above transmission lines total 76 688 km
- Transmission is based on 500 kV system
- Transmission network is upgraded to ultra high-voltage transmission network between eastern and western provinces in China
  - Both UHVAC and UHVDC
  - Coal resources are in northwest, hydro in north, load centers in south and east

# Chinese wind&solar energy industries driven by national renewable energy policies 1



- 2006 Renewable Energy Law
  - Improving the grid connection of renewable power generation projects
  - Feed-in tariffs for renewable power generation: An obligation for grid companies to purchase the full amount of the electricity produced from renewable sources
- 2007 Medium and Long-Term Development Plan for Renewable Energy in China (by National Development and Reform Commission NDRC)
  - The share of renewable energy in China's primary energy consumption to 10 % in 2010 and 15 % by 2015 (BI 2010)
  - The Mandatory Market Share (MMS) for non-hydro renewables in areas covered by large-scale power grids
    - 1 % of generation capacity non-hydro renewables by 2010, and 3 % by 2020
    - Power generators with an installed capacity of over 5 GW to source no less than 3 % of their capacity from non-hydro renewable power by 2010, and 8 % by 2020
  - Installed capacity targets
    - Wind: 5 GW by 2010 and 30 GW by 2020
    - Solar: 300 MW by 2010 and 1,8 GW by 2020
- 2008: 10 GW Size Wind Base Programme
  - The National Energy Administration highlighted wind energy as a priority for diversifying China's energy mix, which is currently heavily reliant on coal.
  - The bureau selected six locations from the provinces with the best wind resources: Xinjiang, Inner Mongolia, Gansu, Hebei and Jiangsu. Each site will have more than 10 GW of installed capacity by 2020. The Wind Base projects aims to build 127,5 GW of wind capacity by 2020.

## Chinese wind&solar energy industries driven by national renewable energy policies 2



- 2009 Renewable Energy Law amendments
  - Priority grid access for wind farms
  - A requirement for grid operators to purchase a certain fixed amount of renewable energy
  - A requirement for grid companies to enhance the power grids capability to absorb the full amount of renewable electricity produced
    - Companies can apply for subsidies from "Renewable Energy Fund" to cover the extra cost
- Renewable Energy Premium
  - Price difference between the electricity from renewable energy and that from coal-fired generation is shared across all electricity users
  - In 2006, a premium of 0,001RMB/kWh (€0,01 cent) was added to the cost of each kWh electricity sold
  - In 2008, the premium was raised to 0,002RMB/kWh (€0,02 cent) and in November 2009 to 0,004RMB/kWh (€0,04 cent)
- Green stimulus package
  - Unofficial targets to generating at least 100 GW in wind power by 2020
  - China intends to invest \$440bn over 10-year period in renewables
  - The share of green energy to account for 6 % of generation capacity by 2020
- In 2009, China scrapped a law stating that 70 % of products and technologies used for wind power projects should be domestically sourced



## Chinese wind power feed-in tariffs

- New system in effect from Aug 1, 2009
- Differentiated based on 4 wind energy zones
- Feed-in-tariff ranges from 0,51RMB/kWh (€5,4 cents) to 0,61RMB/kWh (€6,5 cents) and applies for the entire operational period of a wind farm (20 years)
- Costs above the cost of coal-fired generation will be split between provincial grid operators and the central government

Renewable Tariffs in China							
	Years	Full Load Hours	Capacity Factor	9.80144 €/kWh	1.57373 CAD/kWh	1.43503 USD/kWh	CHN/kWh
Wind							
Category 1 Energy Zone				0.052	0.082	0.075	0.51
Category 2 Energy Zone				0.055	0.087	0.079	0.54
Category 3 Energy Zone				0.059	0.093	0.085	0.58
Category 4 Energy Zone				0.062	0.098	0.089	0.61

Source: NDRC Pricing Reg. (2009)1906, July 20, 2009. Translation by LBL.  
The tariffs for new projects were to go into effect August 1, 2009.

Category 1 Energy Zone: Inner Mongolia - excl. Chifeng, Tongliao, Xing-an County, Hulunbei-er; Xinjiang, incl. Urumqi, Yili-Kazak Autonomous Region, Changji County, Kelamayi, Shi-he-zi.

Category 2 Energy Zone: Hebei Province, incl. Zhangjiakou, Chengde; Inner Mongolia, incl. Chifeng, Tongliao, Xing-an, Hulunbei-er; Gansu Province, incl. Zhangye, Jiayuguan, Jiuquan.

Category 3 Energy Zone: Jilin, incl. Baicheng, Songyuan; Heilongjiang Province, incl. Jixi, Shuangyashan, Qitaihe, Suihua, Yichun, Daxing-anling; Gansu Province, excl. Zhangye, Jiayuguan, Jiuquan; Xinjiang, excl. Urumqi, Yili Kasak Autonomous Region, Changji, Kelamayi, Shi-he-zi; Ningxia.

Category 4 Energy Zone: Other region not included in Categories 1, 2 and 3.

## Chinese solar power subsidy schemes

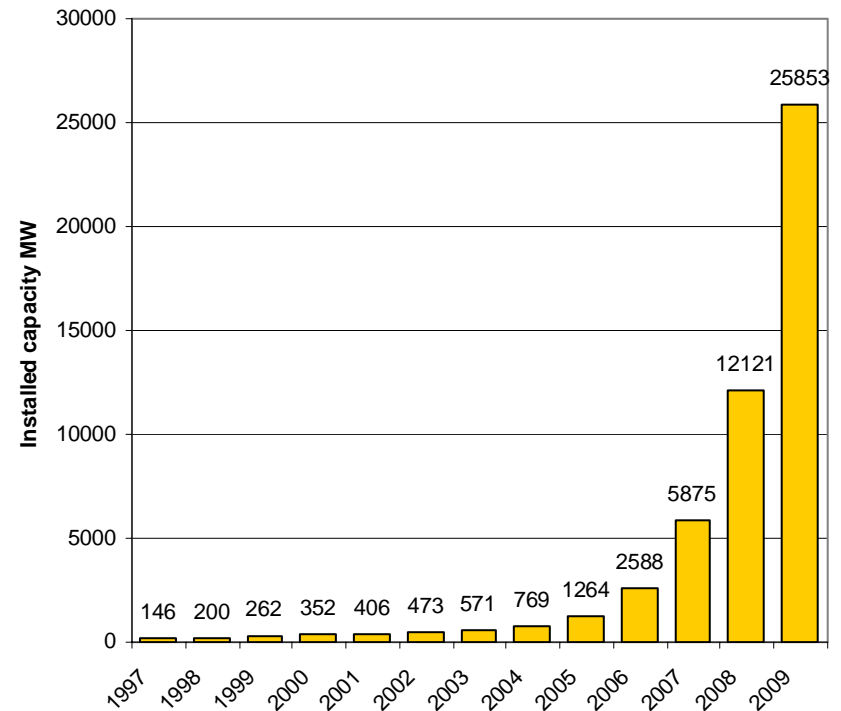


- Solar power feed-in tariffs were introduced in 2009
- The FIT will likely fall between 1.09 yuan and 1.5 yuan (\$0.16-0.22) per kWh of electricity produced at large-scale photovoltaic (PV) arrays, and will be in place by the end of the year
  
- In 2009, China announced a \$2,9 bn investment program to boost the use of solar power (BI 2010)
  - Aim: 2 GW power generation capacity by 2011, 20 GW by 2020
  - Chinese government will subsidize 50 % of the investment, installation and transmission costs

## China - Installed wind power capacity



- Installed wind power capacity reached 25 853 MW by the end of 2009, China ranks second after US (35 159 MW)
- In 2009, China had the largest wind power capacity addition (13 732 MW), US was second with 9 922 MW



## China - Wind power potential



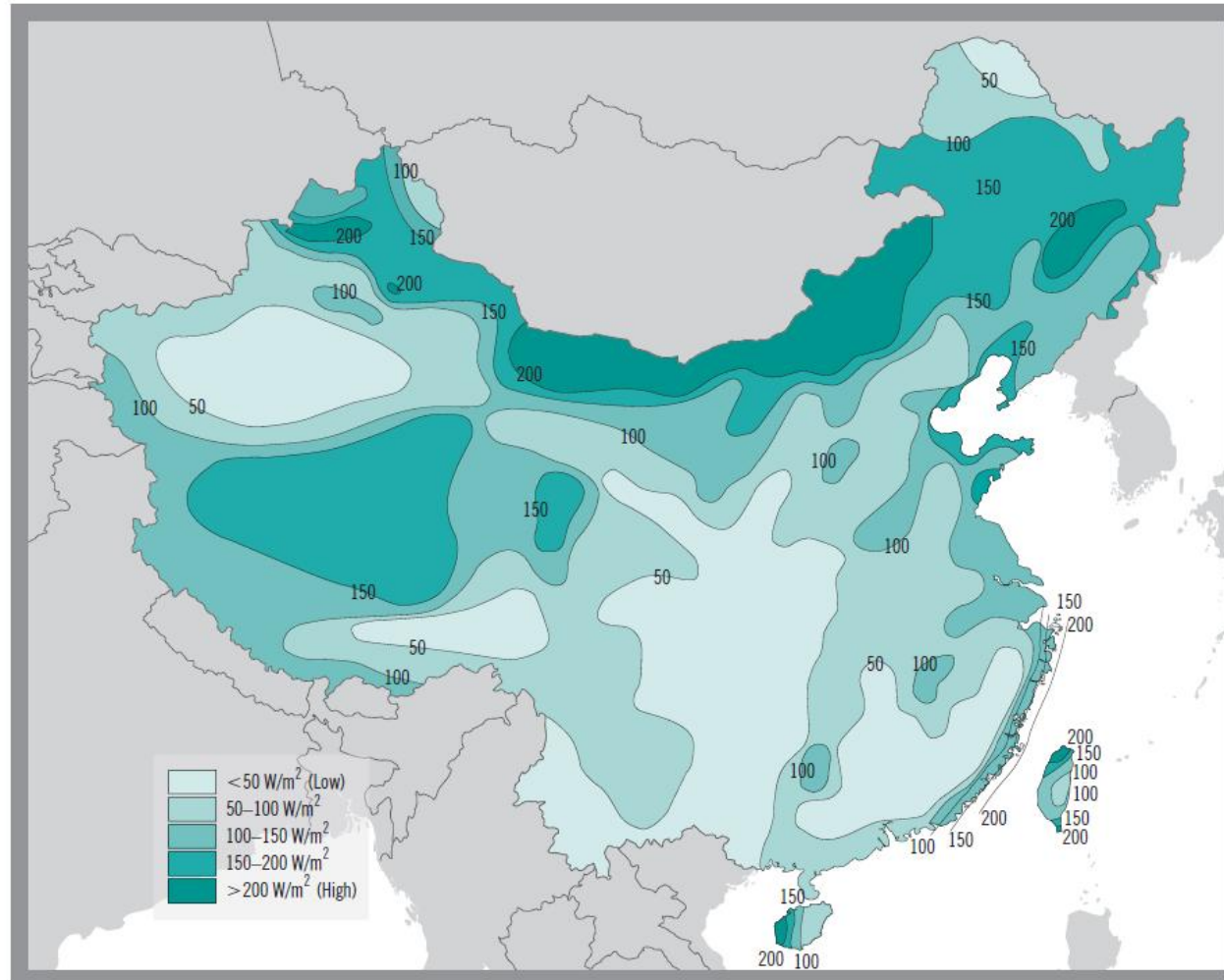
- The third national wind energy resource survey by the China Meteorological Administration (CMA) based on meterings from 10m height
  - Technically exploitable on-shore wind resources 250-300 GW, off-shore potential around 750 GW
- Solar and Wind Energy Resource Assessment (SWERA) by National Renewable Energy Laboratory (NREL)
  - Exploitable resource potential at 50m is estimated at 3250 GW on land and 800 GW off-shore
- Centre for Wind and Solar Energy Assessment
  - Technically exploitable potential on-shore 2680 GW and off-shore potential 180 GW
- Economically exploitable wind resource potential around 30 % of technical potential
  - Land-use restrictions, the existing transmission grid, accessibility with regard to infrastructure
- Most commonly sited estimate on economically exploitable potential 1000 GW including both on- and off-shore installations
- CMA is preparing new, more detailed nation-wide wind resource survey. Survey is supposed to be completed by 2011.



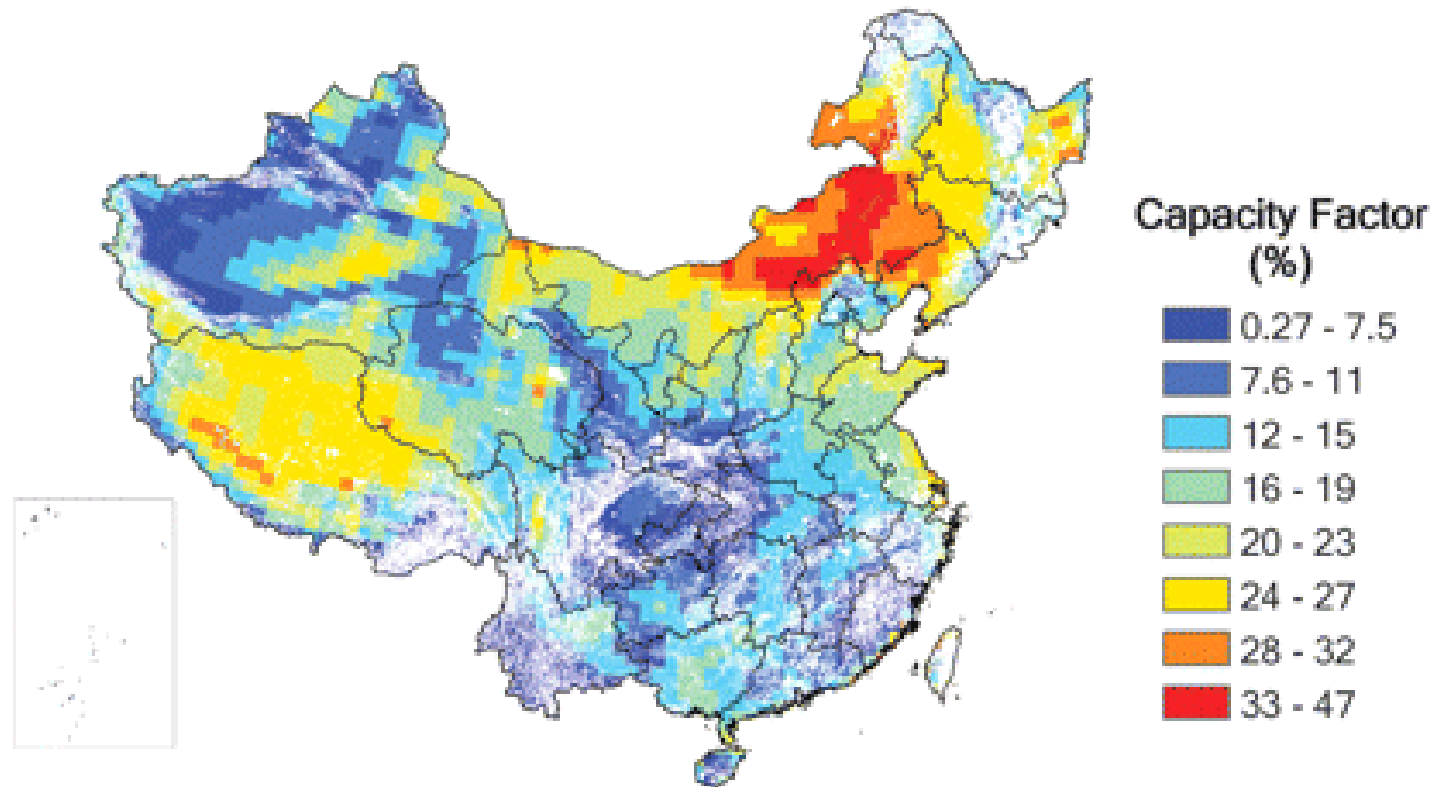
## Distribution of wind power density in China



DISTRIBUTION OF EFFECTIVE WIND POWER DENSITY IN CHINA



## Wind resource in China

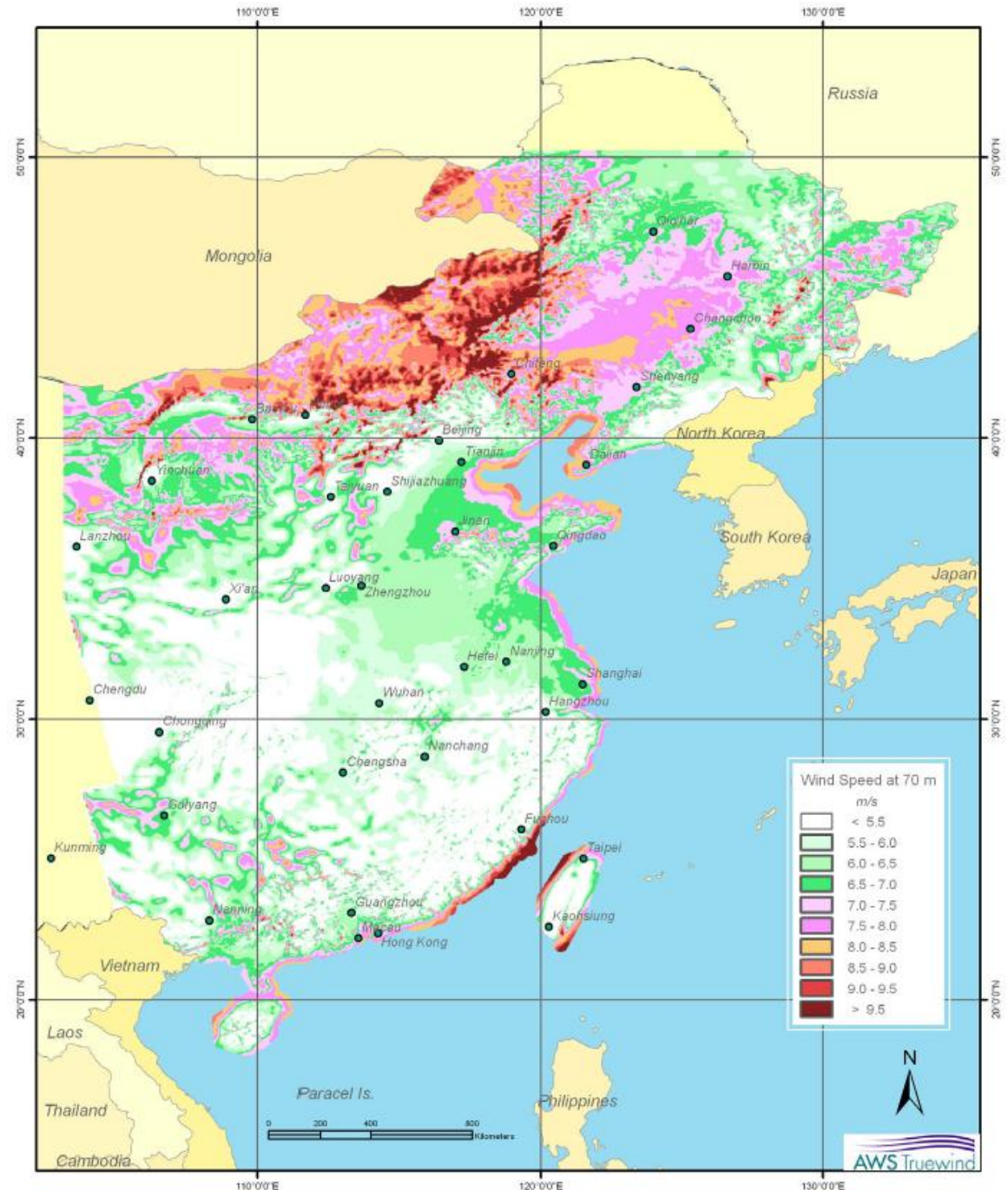


*Potential for Wind-Generated Electricity in China*, Michael B. McElroy, Xi Lu, Chris P. Nielsen, and Yuxuan Wang (2009) *Science* 325 (5946), 1378.



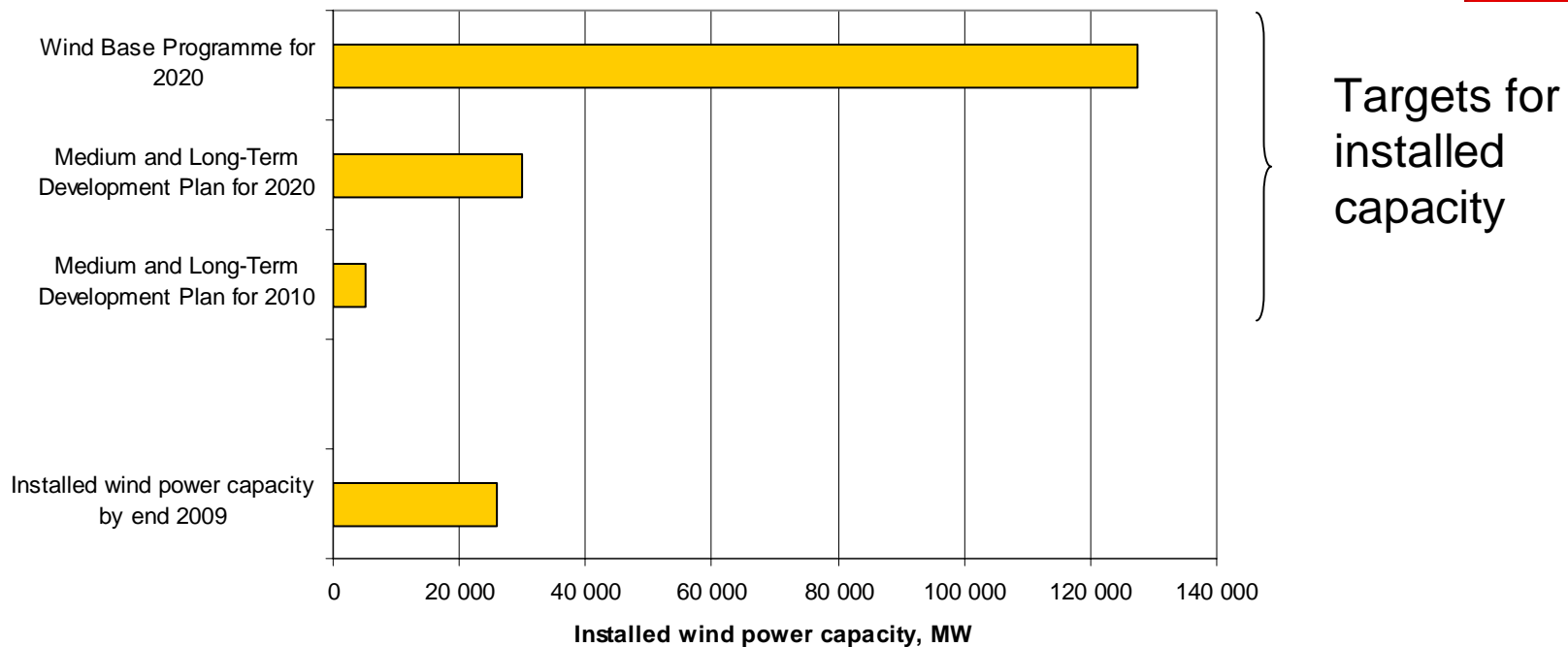
# More accurate wind resource map from eastern China

## Wind speed at 70 meters



New High-Resolution Wind Resource Maps of China, Michael Brower, Bruce Bailey and John Zack, AWS Truwind, LLC

## China: Summary for wind power

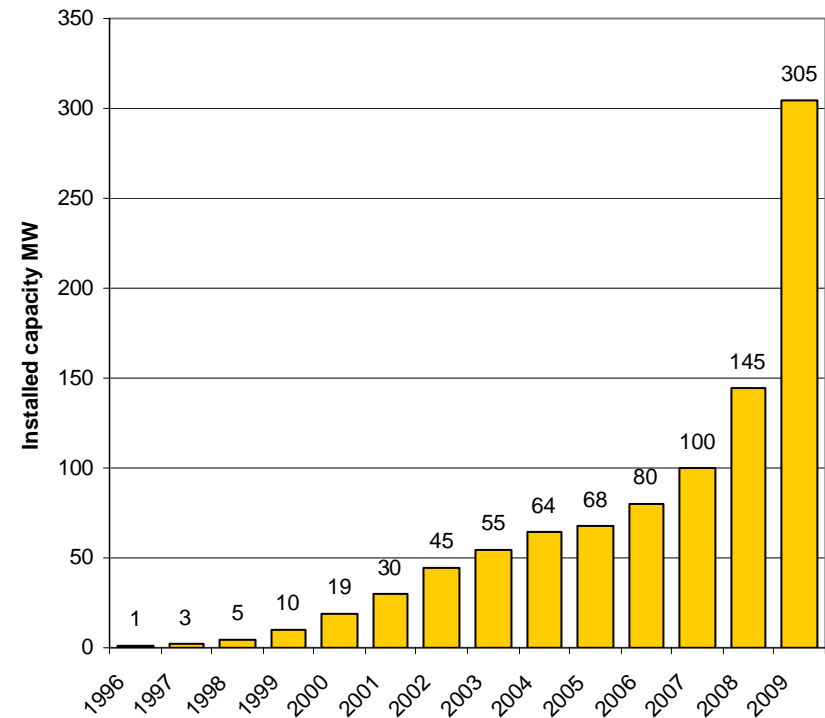


- GWEC Market forecast 2010-2014: China is set to continue the rapid upscaling of its wind capacity and hold its position as the world's largest annual market. Annual additions are expected to be well over 20 GW in China by 2014.
- The target of the Wind Base Programme would be surpassed by just maintaining the level of installations in 2009 → the main challenge will be in grid infrastructure to deliver wind power from production sites to load centers
- [GWEC](#) foresees much larger capacity additions, ranging from 70 GW (Reference scenario) to 200 GW (Moderate scenario) and 250 GW (Advanced scenario)

## China - installed solar power capacity



- Installed solar power capacity reached 305 MW in 2009.
- Capacity more than doubled in 2009, but is still low compared to installed wind power capacity (25 853 MW).

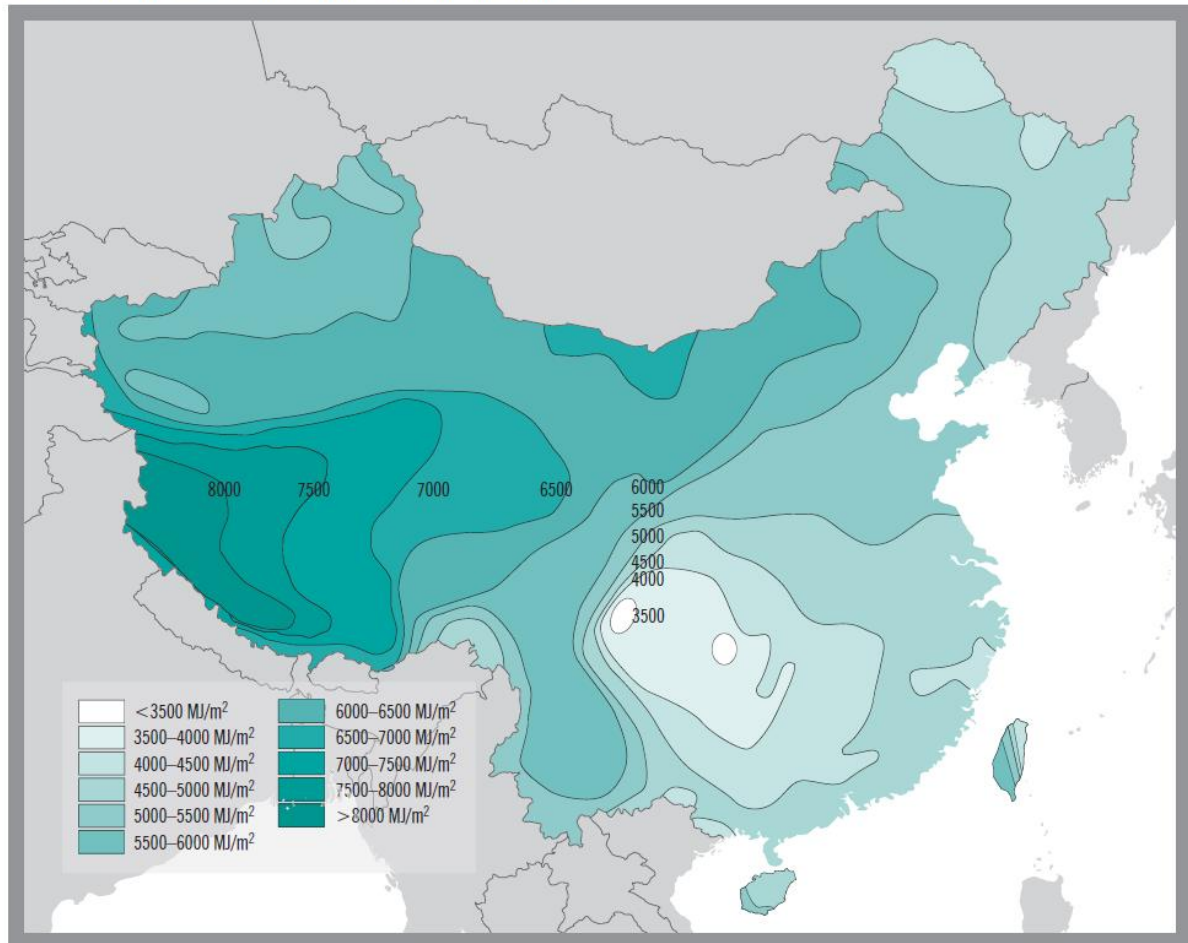


## Distribution of solar power density in China



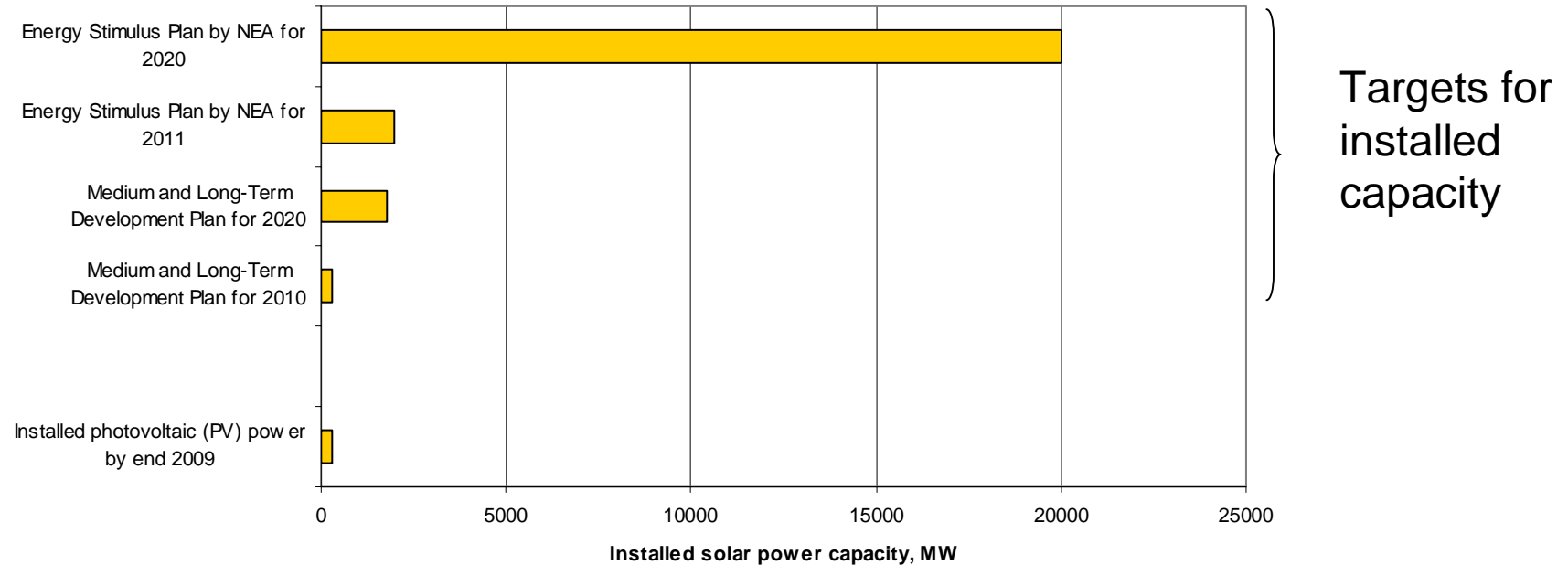
DISTRIBUTION OF SOLAR POWER DENSITY IN CHINA

- In most regions, the annual average daily solar radiation is greater than 4 kWh/m<sup>2</sup>
- Largest radiation in Tibet: up to 7 kWh/m<sup>2</sup>





## Summary for solar power in China



- Current solar power capacity still low, 305 MW in the end of 2009
- Large capacity additions expected, but targets for 2020 low compared to wind power targets



# India



## Challenges for the Indian power sector: ensuring economic growth and minimising GHG-emissions



- India aims to maintain its economic growth in between 8-10 % over the next 25 years
- Economic growth leads to rapidly increasing electricity consumption
- Electrification still ongoing: 44 % of households do not have access to electricity
  - Rural Electrification Policy 2006: the electrification of all villages in India must be completed by 2012. Of 80 000 villages that have no electricity, over 18 000 must be electrified with renewable energy
- In 2007, India was the sixth-largest emitter of greenhouse gases in the world
  - Per capita emissions are low: 1.05 tonne against world average 4.22 tonne
- India's position on climate change:
  - There should be no adverse impact of GHG mitigation on GDP growth and poverty alleviation in developing countries
  - GHG mitigation must be based on the principle of common but differentiated responsibilities (including historical emission levels) and respective capabilities and result in actual global reduction in GHG emissions
  - India targets to reducing the level of emissions intensity

## India - Supply and demand



- Installed power generation capacity 148 000 MW
- Large hydro resources
- Domestic coal dominates the fuel mix. In future, country moves towards imported coal to meet its energy demand
- Due to limitations in use of coal (environmental factors, quality, supply constraints), gas consumption in power sector is also expected to increase
- Generation resources are unevenly distributed and far away from load centers
- Rapidly increasing power demand
- India has a peak demand shortage of around 15 % (15 800 MW)

Power generation in 2007	TWh	%
Coal	537	67,8 %
Oil	36	4,5 %
Gas	66	8,3 %
Nuclear	17	2,1 %
Hydro	124	15,7 %
Wind	12	1,5 %
Other Renewables	2	0,3 %
<b>Total</b>	<b>792</b>	<b>100 %</b>

## Overview of the Indian transmission network



- National load dispatch centre (NLDC) and five regional dispatch centers, operated by Central Transmission Utility (CTU)
- Northern, Eastern, North Eastern and Western Regional Grids operate in synchronous mode since 2006
- More than 40 % of India's households do not have access to electricity
- States are responsible for generation, transmission and distribution within state borders
- Not enough high-voltage transmission capacity between regions
- The Indian Electricity Grid code (IEGC) available at:  
<http://www.wrldc.com/docs/gridcode.pdf>



## Indian electricity market reform



- 2003 The Electricity Act
  - Unbundling of former generation & transmission monopolies (State Electricity Boards, SEBs)
  - Creation of transmission utilities at the central and state level
  - Provision for separating the load dispatch function from transmission utility
  - Promotion of competition and electricity trading
  - State Electricity Regulatory Commissions (SERCs) were given the power to promote renewable energy sources and specify a portion of total consumption of electricity in a given area to be sourced from renewable energy
  
- Long-term bilateral/multilateral contracts still dominate on wholesale power market
  
- Development of a short-term trading market ongoing
  - Power exchange based day-ahead trading at interstate level commenced mid-2008
  - Intra-day and term-ahead contracts were introduced in 2009
  - All trades are for physical delivery only, no financial instruments

## Regulatory structure: both Centre and states can legislate



- The Ministry of New and Renewable Energy ([MNRE](#))
  - Development of all renewable forms of energy
  - Indian Renewable Energy Development Agency Limited ([IREDA](#)) is under the administrative control of MNRE
- The Ministry of Power ([MoP](#))
  - Responsible for the development of electricity industry in India
- Central Electricity Authority ([CEA](#))
  - Advises the Central Government, plans electricity system, coordinates the activities of the planning agencies, specifies technical standards for construction of electrical plants, electric lines and grid connection
- Central Electricity Regulatory Commission ([CERC](#))
  - "The Commission intends to promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers."
- State Electricity Regulatory Commissions (SERCs)

## Five-year plans for the development of new and renewable energy



- India's [11<sup>th</sup> five-year plan](#) for 2007-2012 sets targets for solar and wind power capacity
  - 11th plan outlines a total of 24 200 MW in installed capacity for renewable energy by the end of 2012 (grid interactive power)
  - Grid interactive installed wind power capacity is expected to be 17 500 MW and installed solar power capacity 3 MW by the end of 2012
  - Also targets for distributed remote rural applications (no grid connection)

Grid interactive capacity (MW)	Up to 9th plan (end of 2002)	Up to 10th plan (end of 2007)	11th plan (end of 2012)	12th and 13th plans (end of 2022)	Total
Wind power	1667	5333	10500	22500	40000
Small hydro power	1438	522	1400	3140	6500
Bio power	368	669	2100	4363	7500
Solar power	2	1	-	-	3
<b>Total</b>	<b>3475</b>	<b>6525</b>	<b>14000</b>	<b>30003</b>	<b>54003</b>

## National Action Plan on Climate Change and Integrated Energy Policy



- 2008 National Action Plan on Climate Change
  - National missions: solar power, energy efficiency, sustainable habitat, water, the Himalayan ecosystem, re-afforestation, agriculture and building knowledge of climate issues
  - Aims at significantly increasing the share of solar energy
  
- 2009 Integrated Energy Policy
  - India will have to generate an economic growth rate of between 8-10% over the next 25 years to meet its human development goals and eliminate poverty. This requires India to increase its electricity generation capacity by five to six times over the same period.
  - By 2031-2032, power generation capacity must increase to 800 GW.
  - By 2031-2032, non-hydro renewables should comprise 5-6 % of India's primary energy

## National Solar Mission launched in 2010



- The mission anticipates achieving grid parity by 2022 and parity with coal-based thermal power by 2030
- [National Solar Mission](#)'s targets are
  - To create an enabling policy framework for the deployment of 20 000 MW of solar power by 2022
    - This target is dependent on the learning of the first two phases
  - To ramp up capacity of grid-connected solar power generation to 1 000 MW by 2013, an additional 3 000 MW by 2017 through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff
  - To promote programmes for off grid applications, reaching 1 000 MW by 2017 and 2 000 MW by 2022
- The key driver for promoting solar power will be Renewable Purchase Obligations (RPOs) mandated for power utilities, with a specific solar component



## Renewable energy support schemes by Central and State Governments



- Central Government:
  - Fiscal and financial incentives
    - Provision for 80 % accelerated depreciation for wind farms over one or two years
    - Income tax exemption on profits for power generation
    - Exise duty exemption
    - Concessional custom duty for specific critical components
  - Government has set up the Indian Renewable Energy Development Agency (IREDA) and the Centre for Wind Energy Technology (C-WET)
- State Governments
  - Power wheeling and banking facilities
  - Sale tax concession benefits
  - Electricity tax exemption
  - Capital subsidy
  - 18 out of 29 states have implemented quotas for a renewable energy share of up to 10 % and have introduced preferential tariffs for renewable electricity (RPO)
    - Nine states of these states have introduced feed-in-tariffs to promote renewable-based electricity (Feed-in-tariff usually amounts Rs 3.10- RS 4.3 (€5.1-7.1 cents) per kWh)

## State-wise feed-in-tariffs and Renewable Purchase Obligations (RPOs) for wind power



State	Tariff (Rs/kWh)	Tariff information (escalation etc)	Renewable Purchase Obligation (RPO)
Andhra Pradesh	3,37	Freezed for 10 years	0,5 %
Gujarat	3,37	Fixed for 20 years	2 %
Karnataka	3,4	Fixed for 10 years	7-10 %
Kerala	3,14	Fixed for 20 years	2 %
Madhya Pradesh	4,03	With an annual reduction of Rs 0,17 per unit for 4 years and then constant at Rs 3,36 per unit from 5th year onwards to 20th year	10 %
Maharashtra	3,5	Escalation of Rs 0,15 per unit for 13 years	6% (2009-1010)
Rajasthan	4,28 / 4,50	4,50 per unit for Jaisalmer, Jodhpur etc. and Rs 4,28 per unit for other districts	7,45 % (2009-2010), 8,50 % (2010-2011)
Tamil Nadu	3,39	Levelised	10 %
Punjab	3,36	Five annual escalation at 5 % up to 2012	7,45 % (2009-2010), 8,50 % (2010-2011), 9,50 % (2011-2012)
Haryana	4,08	With 1,5 % escalation per year	5 % (2008-2009)
West Bengal	4	To be decided on case by case (cap)	4-6,8 % (2009-2010), 7- 8,3 % (2010-2011), 10 % (2011-2012)

## In 2009, India introduced Generation Based Incentives (GBI)



- The GBI Scheme is applicable only for those power producers who do not avail of the accelerated depreciation benefits under the Income Tax Act
  - These producers include Independent Power Producers IPPs and foreign investors
- Grid integrated projects of capacity of more than 5 MW shall be eligible for this scheme
- Project should be synchronized with the grid and certified by the utility
- Wind site should be validated by C-WET
- Electricity generated from the project should be sold to the grid
- The MNRE will provide the GBI of Rs.0.50 per unit for a period of ten years to the eligible project promoters through IREDA. This incentive shall be in addition to the tariff determined by the SERC
- GBI is limited to cover a maximum capacity addition of 4 000 MW during the 11th Plan.

## India - estimated wind potentials



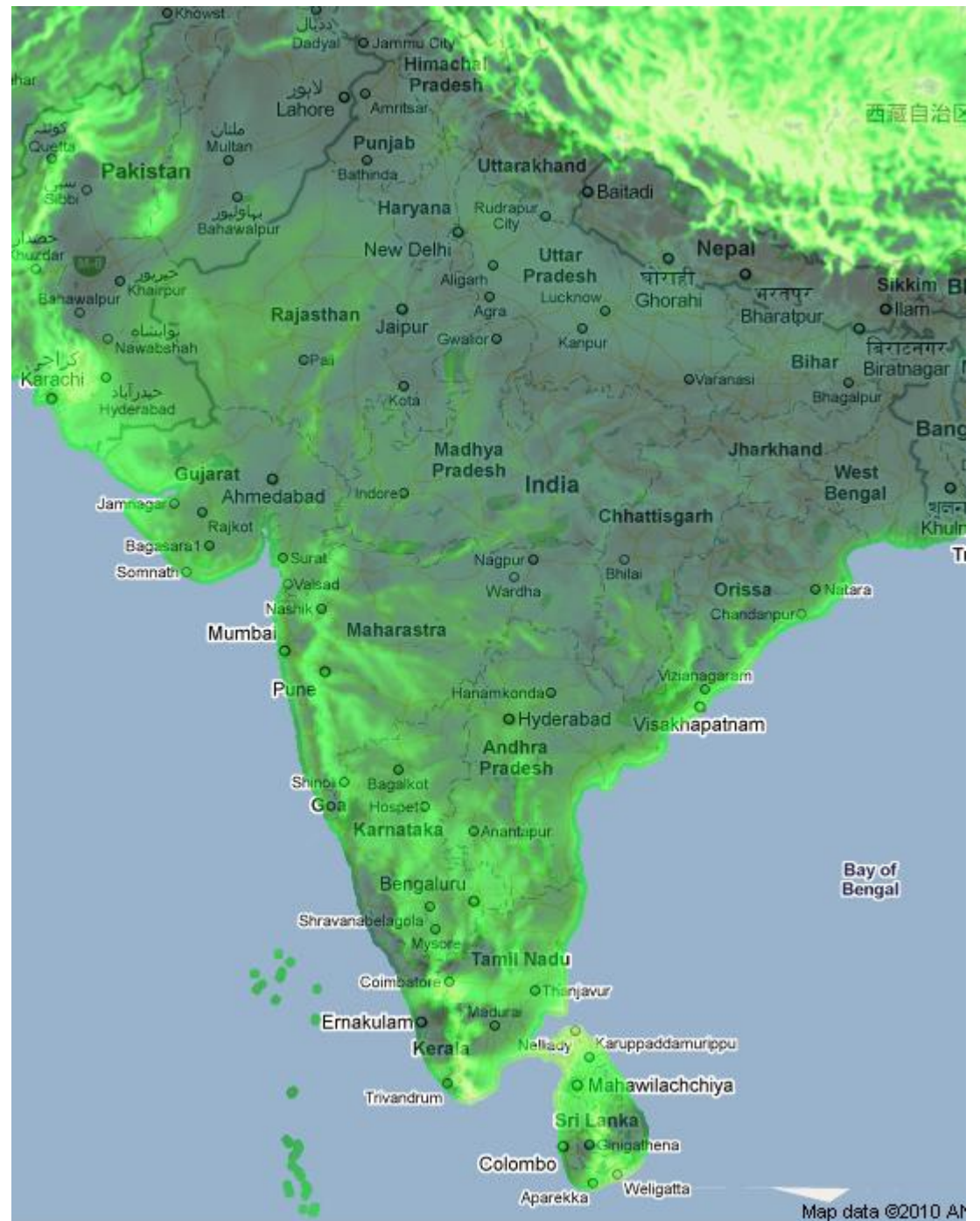
- Wind power potential was first estimated by the Centre for Wind Energy Technology (C-WET) at around 45 GW, and was recently increased to 48,5 GW
  - Study was based on comprehensive wind mapping, but only 9 states were included and the wind measurements were carried out at low hub heights (50 m)
- At greater heights, the Indian Wind Turbine Manufacturers Association (IWTMA) estimates the potential around 65-70 GW
- World Institute for Sustainable Energy, India (WISE) considers that with large wind turbines, greater land availability and expanded resource exploration the potential could be 100 GW
- The Wind Resource Assessment (WRA) Programme ongoing
- Wind Atlas Book is under preparation of publication

Wind power potential by state	Potential (MW)
Andhra Pradesh	8968
Gujarat	10645
Karnataka	11531
Kerala	1171
Madhya Pradesh	1019
Maharashtra	4584
Orissa	255
Rajasthan	4858
Tamin Nadu	5530
<b>Total</b>	<b>48561</b>

Data: MNRE Annual report 2009-2010



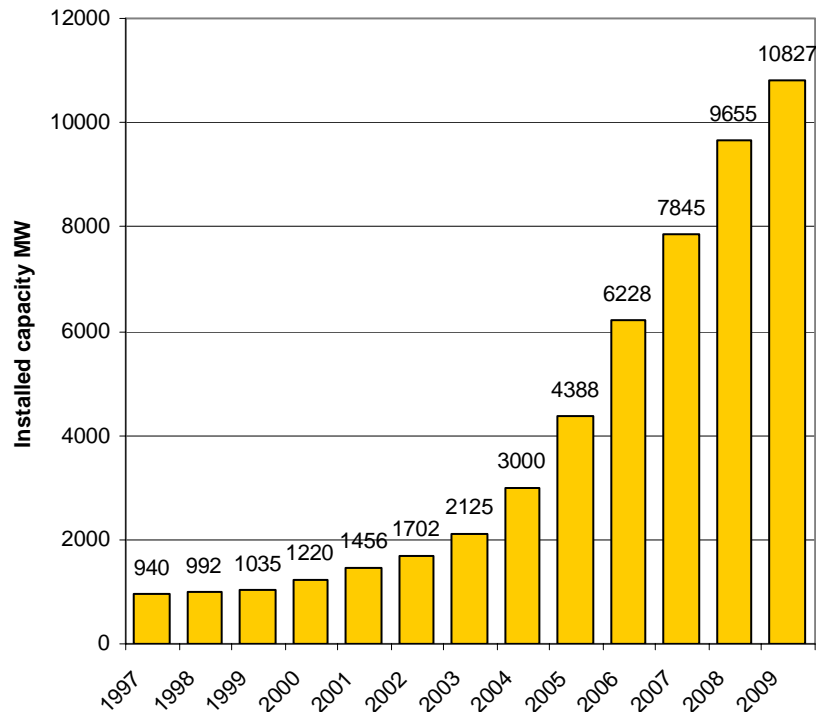
## Wind Resource in India 'Wind rank' by 3Tier



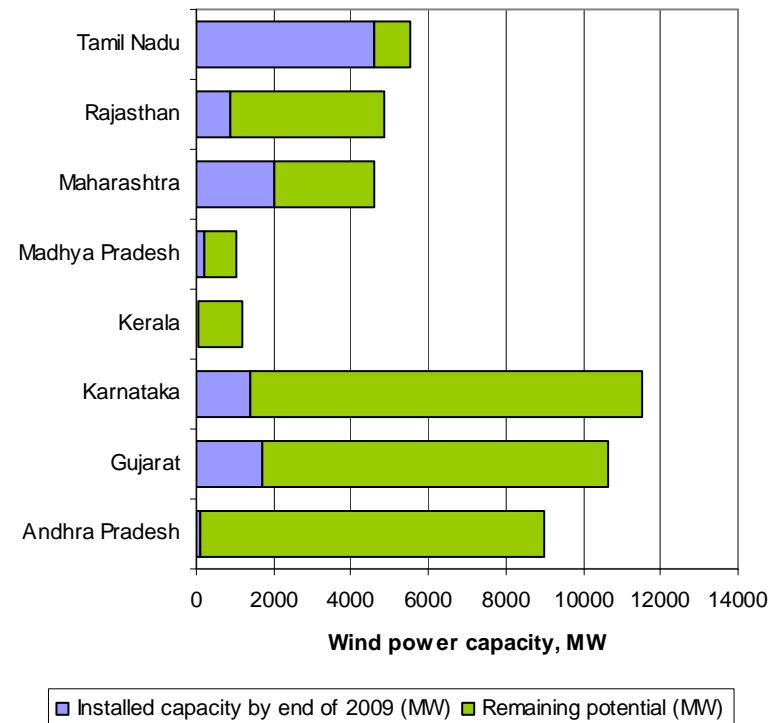
## India - installed wind power capacity - current state



Total wind power capacity in India

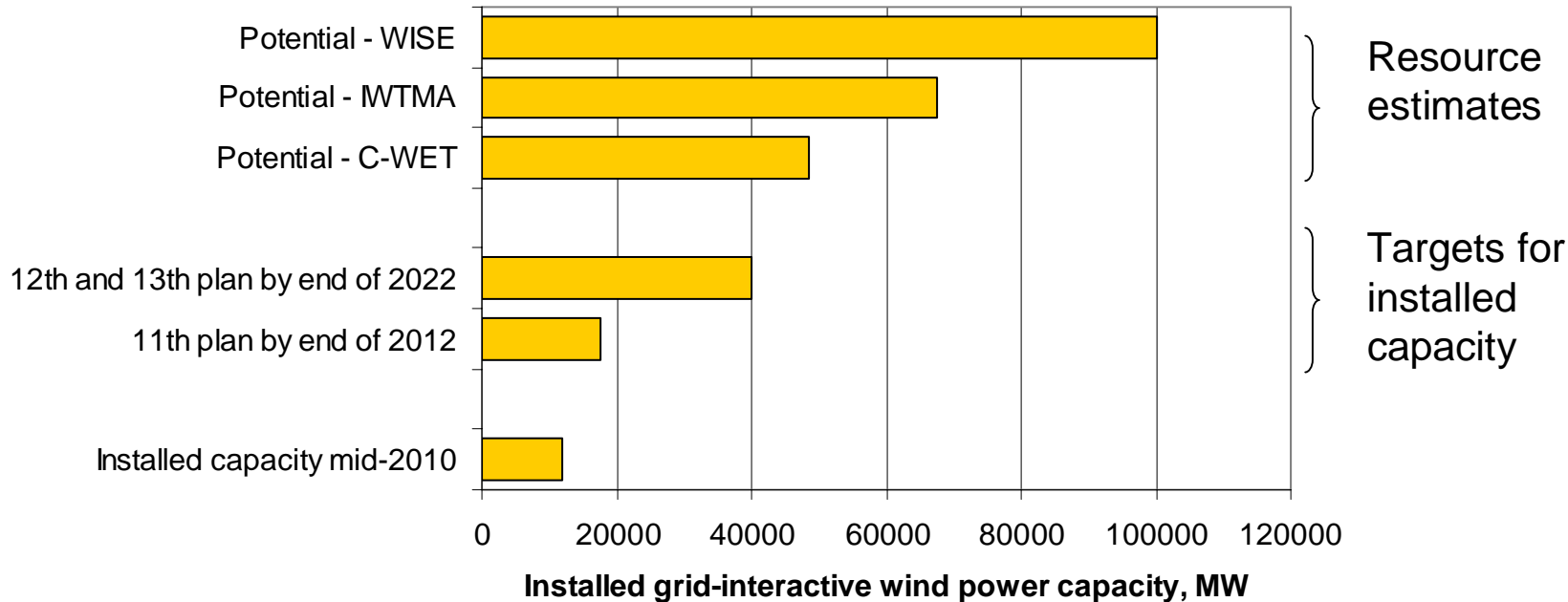


Installed capacity and remaining potential by state



- India is fifth-largest wind power producer in the world
- Installed grid-interactive wind power capacity 12,0 GW (end of June 2010)
- Leading wind power state remains Tamil Nadu (installed capacity 4,6 GW), followed by Maharashtra and Gujarat

## India - Summary for wind power



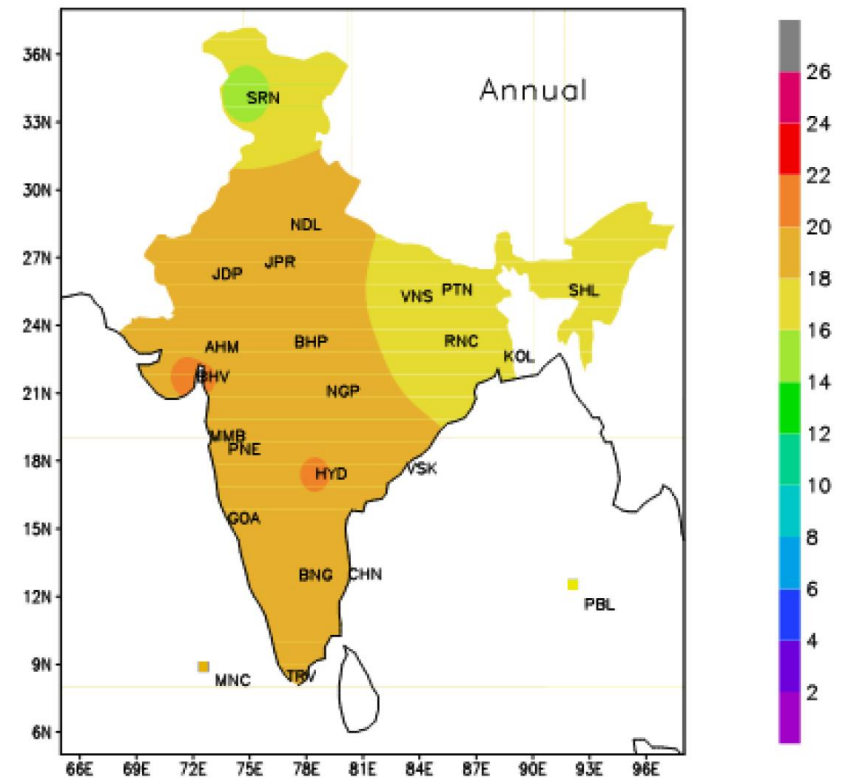
- Official wind potential estimates are highly conservative compared to recent estimates on technical potential (e.g [Global potential for wind-generated electricity](#) Xi Lu, Michael B. McElroy, and Juha Kiviluoma. PNAS, 2009, vol. 106, no. 27, pp. 10933–10938)
- In [GWEC scenarios](#) for 2020, wind capacity in India ranges from 24 GW (Reference scenario) to 46 GW (Moderate scenario) and 65 GW (Advanced scenario).

## India - Estimated solar potentials



- National solar mission: about 5000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per m<sup>2</sup> per day

Global solar radiant exposure over the year (MJ/m<sup>2</sup>)

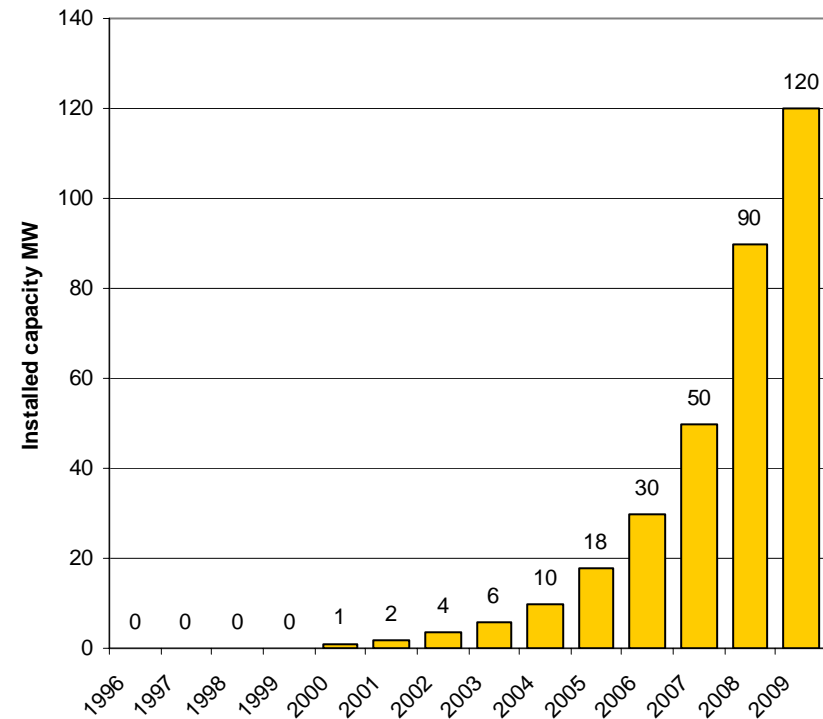




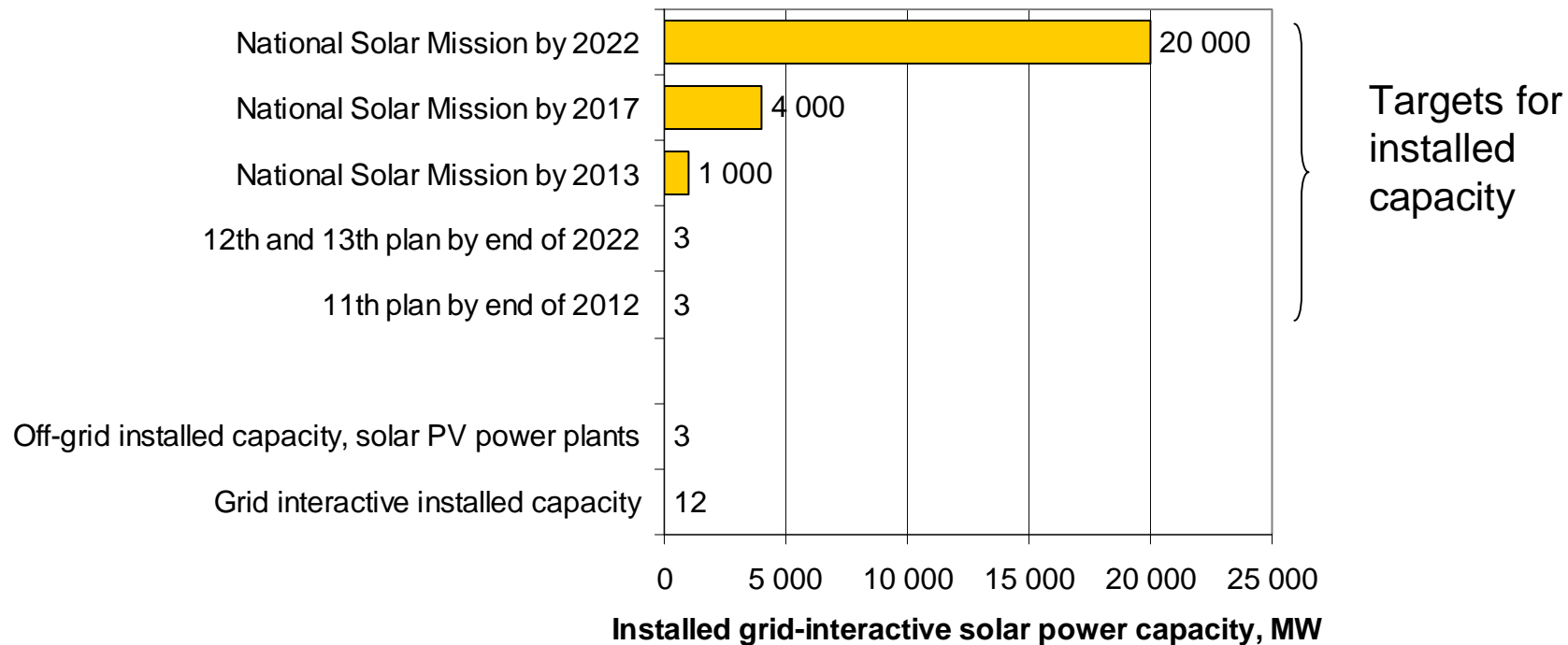
## India - Installed solar power capacity



- Installed grid-interactive solar power capacity 12,3 MW (end of June 2010)
- Installed off-grid solar PV power plants 2,9 MWp



## India - Summary for solar power



- Large increases expected in Indian solar power capacity
- Main subsidy scheme, Jawaharlal Nehru National Solar Mission, has already had its first bidding round for 650 MW. The Ministry of New and Renewable Energy received bids for nearly 2 GW.
- Second bidding round (350 MW) is expected in 2011



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